Marine seismic reflection data provide insight into the architecture of a Mesozoic accretionary prism, Otago Schist, New Zealand

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Mesozoic schists of the Rakaia and Caples terranes (Otago Schist belt) extend offshore on the east coast of the South Island of New Zealand under 1 – 2 km of Cenozoic sedimentary and volcanic rocks. Onshore, the belt comprises psammitic and pelitic schist. Their penetrative horizontal to gently dipping fabric defines a broad, regional, northwest-southeast trending antiform axis. The Rakaia and Caples terranes were juxtaposed during prolonged subduction along the Gondwana margin in the mid-late Mesozoic. The Otago Schist belt formed across both terranes as a metamorphic overprint that peaked in the Jurassic. The antiformal axes onshore represent the locus of maximum exhumation. The contact between the Rakaia Terrane in the north and Caples Terrane in the south is subtle but the geochemistry and aeromagnetic data can be used to separate these terranes into components of an exhumed Mesozoic accretionary prism. The southeast-striking Waihemo Fault and Hyde-Macraes Shear Zone mark major boundaries between schist blocks. The Hyde-Macraes Shear Zone has significant economic importance as it hosts the country's largest orogenic gold deposit (Macraes Mine). Seismic reflection data have been trialed onshore for mineral exploration but the acquisition is challenging. However, marine seismic data collected during a deep crustal reflection experiment in 1996 (SIGHT96) demonstrated that the metamorphic basement was highly reflective from surface to the Moho.

Immediately offshore, single-channel seismic and boomer data have mapped a complex transition from the southeast-striking faults seen on land, to a north-northeast striking set of overprinting faults that lie within the sedimentary cover. Reprocessing the top 10 seconds of the SIGHT96 lines by exploration companies, combined with acquisition of additional seismic lines recorded using long streamers and long record lengths, provides a three-dimensional view of the crustal reflectivity. By utilising all of these seismic lines we have improved the interpretation of the Otago Schist basement in terms of terrane boundaries, shear zones, and faults in the offshore region. Marine magnetic data help identify intrusive igneous rocks and the roots of Tertiary volcanoes that overlie the Mesozoic metamorphic rocks. The dipping belts of reflectivity in the crust represent deeper parts of the accretionary prism within the Rakaia Terrane. The strong reflectors are interpreted to be major fault zones within the accretionary wedge that guided the path of fluids upwards away from the subducting sediments and oceanic crust.

A similar, highly-reflective and schistose metamorphic domain is thought to exist below the western edge of the currently active Hikurangi subduction margin on the east coast of New Zealand's North Island. The geometries mapped within the onshore and offshore Otago Schist belt are being used to help interpret seismic refraction and wide-angle reflection data across the modern accretionary wedge.